1859MNRAS..19..161M

The Observatory at the Collegio Romano.
Observatory at San Fernando.
The Department of State, Washington.
The Franklin Institute.
The Canadian Institution.
The Editor of the Athenæum.
The Editor of the Literary Gazette.
The Editor of the Critic.
The Editor of the Civil Engineers and Architects' Journal.

R. Abbatt, Esq.
G. B. Airy, Esq.
M. Moritz Allé.
M. J. B. Biot.
W. R. Birt, Esq.
Thos. Brett, Esq.
J. A. Broun, Esq.
Dr. Cabish.
R. C. Carrington, Esq.
Rev. Prof. Challis.
E. H. Coleman, Esq.
M. D'Abbadie.
Prof. De Morgan.
S. M. Drach, Esq.
Prof. Encke.
Chas. Frodsham, Esq.
Dr. J. G. Galle.
Prof. A. Gautier.
Jas. Glaisher, Esq.
Dr. B. A. Gould.
H. Hennessey, Esq.
J. Herapath, Esq.
M. M. Hoek.
Messrs. Hannay and Dietrichsen.
M. J. Hornstein.
M. J. Houel.
Dr. Hume.
Prof. Jolly.
Mrs. Hannah Jackson.
Dr. Lee.
M. Le Verrier.
M. K. Von Littrow.
M. Moritz Löwy.
Lieut. Maury.
M. L'Abbé Moigno.
Rev. W. Monk.
J. R. Morrison, Esq.
Prof. B. Peirce.
Dr. Peters.
M. Plana.
M. Plantamour.
Rev. B. Powell.
M. Quetelet.
Geo. Rennie, Esq.
Prof. A. Secchi.
W. H. Simms, Esq.
Prof. C. P. Smyth.
R. B. Smyth, Esq.
M. O. Struve.
R. Taylor, Esq.
Lieut. Tennant.
C. Todd, Esq.
M. Yvon Villarceau.
Mr. J. Williams.
Dr. R. Wolf.
M. Wolfers.

Address delivered by the Chairman, the Rev. Robert Main, on presenting the Gold Medal of the Society to Mr. Carrington.

Gentlemen,—The continued illness of our excellent and respected President has made it necessary for the Council to depute to another member of their body the task of laying

1859MNRAS..19..161M

before you the grounds on which they have assigned the Gold Medal of the Society to our worthy Secretary, Mr. Carrington, for his *Redhill Catalogue of Circumpolar Stars.* The Council have done me the honour to request that I would take this duty upon myself; and I have not hesitated to accede to their wishes, first, because the recognised value and excellence of the work make the task comparatively an easy one, and, secondly, because my daily practice in the routine of a large observatory (of which the meridional instrument is a transit-circle, which the author of the Redhill Catalogue took as his model) has of necessity made me familiar with the processes both of observation and accurate reduction, which are described so luminously by him in his Introduction.

There are two points of view from which every work like the present must be regarded, in order that a judgment may be formed of its merits; namely, its utility, and the excellence of its performance. A work may be well executed, but it may be of no practical utility, or may be only a repetition of what has been done before; or, it may be needed, but it may be so ill executed that the results could not be confidently applied to their intended object. Astronomical science within the last fifty years will easily supply us with illustrations of both these defects in works of importance; but, for obvious reasons, it would not be proper to produce any. I need only show that, in the instance before us, the work is one of great utility, and at the same time of standard excellence, and performed under such circumstances as to render the bestowal of our medal only a proper and fitting acknowledgment, on our part, of the merit which the scientific world has universally acknowledged already.

The utility of any great work must be estimated, in some degree, with reference to the age which produces it. A nation emerging from barbarism, and acquiring by slow and painful degrees the arts of civilisation, invariably commences with those which are fundamentally necessary for its support and extension. It first provides for the bodily sustenance, and for the social and political security of its subjects, before it has leisure to attend to, or cultivation to appreciate, those arts and sciences which are ultimately as necessary to its well-being in its more refined state as were the rude arts by which its citizens were supplied with daily bread at the commencement.

The case has been precisely similar in the organised efforts made to construct and to extend the science of modern astronomy since its commencement in the seventeenth century. Beginning with Flamsteed, the fundamentals of every department of the science had to be determined almost without the help of any adequate theory. The places of the brighter stars were to be determined as fundamental zeros; the elements of the solar and lunar and planetary orbits were to be corrected; and the position of the equinox, as well as the quantity of the

1859MNRAS..19..161M

precessional motion, was to be determined with some degree of precision. In a short time physical and mensurative astronomy began to go hand in hand, and mutually to lend assistance to each other. The discoveries of Newton had shown the physical causes of the irregularities in the apparent motions of the stars, detected by the powerful though ill-contrived instruments of the eighteenth century; and the genius of Bradley was adequate to the task of tracing the sources and the laws of aberration and nutation, after having himself observed their effects. Astronomy was thus placed upon a sure basis. The instrumental means employed towards the close of the eighteenth century, though far from faultless, were sufficient to give the values of all the constants needed in the various branches of astronomy within very narrow limits of error; and to English industry and skill must be conceded the merit of having almost exclusively supplied the materials for doing this.

But the progress of astronomy in the present century soon rendered necessary an extension of its objects and purposes. And it is a fact worthy of notice, gentlemen, that the illustrious astronomer to whom we are indebted for the elaborate and complete discussion of the English observations of the eighteenth century, was the first to set the example of a more extended and systematic survey of the heavens. It is just thirty years ago when the medal of this Society was presented to Professor Bessel for his zone-observations; and Sir John Herschel, who then occupied the presidential chair, used words, while inculcating the importance of carrying out effectually that grand sidereal survey of which the equatoreal zone was the first-fruit, which, coupled with succeeding discoveries, we may well consider to be prophetical.

"Could it be permitted to us," he says, "to look forward and draw aside the veil which a few centuries interpose between us and its interpretation, we might expect to see all the great questions which agitate astronomers set at rest, and new ones, more refined, and grounded on their solution, arising. Some minute and telescopic atom will perhaps have become the stepping-stone between our system and the starry firmament—its parallax will mark it for our neighbours—and either its fixity will demonstrate the equilibrium of our sidereal system, or its proper motion reveal to us the nature and extent of the forces which pervade it."

I need not remind you, gentlemen, that such a stepping-stone has been found, and through the labours of the same astronomer who set the example of the great sidereal survey. The parallax of the star 61 *Cygni* is a recognised element of modern astronomy, and its mass even has been estimated, though on data which still admit of dispute. Other great problems hinted at by Sir John Herschel are either in course of receiving their solutions, or have already received them; and no one now entertains any doubt that the lapse of two or three

1859MNRAS..19..161M

centuries will, in sober earnest, produce all those grand results which to Sir John were then the objects of such faith and hope.

The Königsberg Zone-Observations, you are aware, gentlemen, consisted of two great portions, of which that completed first in the years 1821 to 1825 comprised all the stars down to about the tenth magnitude, lying within 15° of each side of the equator; and the other, executed in the years 1825 to 1833, took in the stars lying between the parallels of 15° and 45° of north declination. You are also aware that the equatoreal zone has been since catalogued with great labour by Professor Weisse, and that this catalogue of nearly 32,000 stars, with its admirable preface by Struve on the distribution of the stars in space, forms one of the most valuable additions to sidereal astronomy in the present century. The next great work of the same class was that of Argelander, who, under unfavourable instrumental circumstances, succeeded in completing the observation of stars lying in two other zones, the one extending from 45° to 80° of north declination, and the other, observed subsequently, from 15° to 31° south declination. Thus, with the exception of one zone, all the stars visible in Europe down to the tenth magnitude, or thereabouts, were provided for, those of Argelander's Northern Zone, to the number of more than 26,000 stars, having been recently, in a most praiseworthy way, reduced and catalogued by M. Oëltzen, assistant at the Vienna Observatory. The only zone of the northern heavens which remained unobserved was that lying within ten degrees of the pole; and this is the one which Mr. Carrington proposed to himself as the subject of his own labours, and for the successful termination of which the Council have awarded to him the Gold Medal of the Society.

This, gentlemen, is the state of the case with respect to the first part of our considerations,—namely, the utility of Mr. Carrington's work. For any general and systematic discussions or speculations respecting the stars in which astronomers may hereafter indulge, it is necessary that the whole of them, down to as low a magnitude as is consistent with the instrumental means ordinarily employed, be observed with moderate accuracy. This, I say, is necessary as the starting-point, or the lowest fundamental condition, if the aspirations of Sir John Herschel, before cited, are to be realised; and it is indispensable, too, that the whole work be accomplished within a moderate interval of time. The polar zone is as important as any of the others, but it is by far the most troublesome and difficult, and it requires far more resources, both instrumental and intellectual, than any of the other zones.

To any of our members who are well acquainted with our worthy Secretary, I need not say that the difficulty would be a recommendation; and to those who have not the advantage of his intimate acquaintance, the reading of his Introduction will tell the same fact quite as clearly. No one can read the intro-

1859MNRAS..19..161M

duction to the Redhill Catalogue,—at least I could not do so myself—without gaining an idea of the positive zest with which he seems to grapple with difficulties and to conquer them one after another as they occur.

But that you may be better able to judge of this and other matters connected with the work, it is necessary that I state to you, briefly, a few points connected with its history and progress.

Mr. Carrington, after passing with distinction the examination for his degree at Cambridge, determined to devote himself to the cultivation of astronomy, and for this purpose accepted the situation of Observer at Durham, where he remained nearly three years. While thus engaged he formed the determination to complete the labours of Bessel and Argelander, by observing the polar zone omitted by them, and, finding that the instruments at his disposal were inadequate to the task, he resolved to resign his appointment and to provide himself with the means of carrying it out by means of his own private resources. The undertaking involved, as far as expense was concerned, the building of a house as well as of an observatory, the furnishing of the latter with an expensive transit-circle and equatoreal, as well as with the other instruments ordinarily needed as their accompaniments, and the payment of an assistant. To this must be added the purchase of the lease of the ground on which his residence stands, and the devotion of his own time, which, from the nature of his previous education, might easily have been so employed as to become a source of considerable income. So much with regard to the devotion of himself and his pecuniary resources to the cause of science,—a most munificent donation, and deserving of all the commendation in our power to bestow, if we were to look no farther.

His chief instruments were, first, a transit-circle made under his directions by Mr. Simms, similar to the Greenwich instrument, but smaller, having a telescope of 5 inches aperture, and 5½ feet focal length; and, secondly, an equatoreal with a telescope of 4½ inches aperture, and rather more than 4 feet focal length. The latter was employed chiefly for roughly observing the stars in the polar zone, and forming the preliminary or working catalogue.

The real work of observing the polar zone commenced in the year 1854 and occupied three years. Each star was observed at least three times, and the whole number which have been observed, thoroughly reduced and catalogued, amounts to 3735. This number includes nineteen stars within one degree of the pole, which, in the reduction, required special treatment, and which, on that account are placed by themselves, and denoted by the italic letters of the alphabet. Some time after the commencement of the observations, Mr. Carrington discovered that the polar zone had been observed by Professor Schwerd of

1859MNRAS..19..161M

Speyer, in the years 1826 to 1828, the limiting parallel being different, and the number of stars observed within Mr. Carrington's limit being about 680. Schwerd's observations have been reduced and catalogued by M. Oëltzen, to whom astronomy is so much indebted for the cataloguing of the stars in Argelander's Northern Zone, and Mr. Carrington has brought up the places to his own epoch and compared them with his own results. This comparison of course greatly increased the labour, but gave occasion for a most elaborate and instructive dissertation on the whole theory of precession, nutation, and aberration, and especially on the application of it in the case of stars very near the pole. This dissertation is itself a remarkable production, though the author disclaims any novelty, and it will repay the attentive study of any astronomers who may be engaged in observations similar to those of Mr. Carrington.

At the risk of being tedious, I must say a few words respecting the processes employed in the observations and reductions. First, I will premise that every care was taken, previously to the commencement of the work, to test the quality and fitness of the instrument. The flexure of its telescope was examined and allowed for, and the rigidity of the cones forming its tube, and of those forming the axis, was tested by the application of weights. It was found difficult to provide for the examination of the divisions of the circle; and the accuracy of these, which were cut with Mr. Simms' dividing engine, as also of the cylindrical form of the pivots, has been assumed. The instrument is collimated by means of two collimating telescopes, one placed north and the other south of it, precisely as in the case of the Greenwich instrument; and the errors of level were observed by means of a Bohnenberger's eye-piece and a trough of mercury, precisely as at Greenwich. So steady was the instrument that the error of level can generally be pretty accurately represented by a formula containing the time from a fixed epoch, denoting permanent change, and a periodical term depending on the sun's longitude, that is, on the season of the year. The azimuthal errors were determined primarily and fundamentally by assumed right ascensions of the four fundamental polar stars of the *Nautical Almanac*, after severe scrutiny of their places as given in the Greenwich and Oxford Observations, and as found by several transits of *Polaris* above and below pole at Redhill, and immediately by the use of these stars, combined with sixteen others called 'Special Polars,' arranged in pairs for their transits above and below the pole.

In the treatment of the north polar distances, these were made fundamentally to depend upon the assumed north polar distances of the same four polar stars of the *Nautical Almanac*, the polar points thence derived being applied to all circle-readings.

I should only weary you, gentlemen, if I should attempt to

1859MNRAS..19..161M

enter into detail with respect to those niceties of manipulation of the instrument, of the means taken for obtaining accurately the clock-errors, or of the ingenious processes employed for economising labour, which only the professional astronomer can appreciate. I have stated the facts concerning the most important features of the work, and I beg you to receive my assurance that everything has been done which honesty of purpose, unwearied industry, and consummate skill, could effect to render it—what I firmly believe it to be—an honour to the country which has produced it.

In whatever light we regard it, whether as a gift to science, or simply as the production of a skilful and laborious astronomer,—whether we regard the laborious fidelity of the details, or the symmetry, completeness, and finish of the accomplished work, it is equally admirable.

Like the painting of some great master, it must be judged by all the rules of art to ensure a correct appreciation of its merits; and, with the additional consideration of the imperishable value of its results, we may indeed say of it, in the language of the Roman poet,—

> "Exegit monumentum ære perennius,
> Regalique situ Pyramidum altius;
> Quod non imber edax, non Aquilo impotens
> Possit diruere, aut innumerabilis
> Annorum series, et fuga temporum."

(*The Rev. R. Main then, delivering the Medal to Mr. Carrington, addressed him in the following terms*):—

Mr. Carrington,—In the name of the Council and Fellows of the Astronomical Society I present you with this Medal as the best tribute which they have it in their power to pay to your industry and talents, displayed in the formation of the *Redhill Catalogue of Stars*, and as the best means at their disposal of expressing their sense of the splendid present which you have in it made to science. They sympathise with you in the domestic bereavement which has for a time had the effect of turning aside your energies into another channel, but they trust that this will be only for a time, and that many years may remain to you in which your devotion to science will enable you to achieve still greater things. Be assured that the best wishes of the Society will always attend you, both for your happiness and enjoyment of the honours you have already earned, and for your successful accomplishment of all that your zeal may in future induce you to undertake.